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January 16, 1992

Susan Chipman
Office of Naval Research
Scientific Officer Code: 1142CS
800 North Quincy Street
Arlington, VA 22217-5000

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ELECTE
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Dear Susan Chipman:

This is the final status report of the ONR grant awarded to Arthur C. Graesser, entitled "Questioning Mechanisms during Complex Learning" (N00014-90-J-1492). This covers the work completed between October, 1991 and January 14, 1992.

We have completed all work on the grant except for the final technical report. We have requested a distribution list and a DTIC Form 50 Accession Notice for preparing this final report (see enclosed abstract). In November, we sent Susan Chipman a productivity report and briefing materials for our previous ONR grants. Finally, we have sent in a proposal for a renewal grant (entitled "Questioning Mechanisms during Tutoring, Conversation, and Human-computer Interaction") and an associated AASERT proposal to fund two graduate students. We are awaiting a final decision on these proposals.

Sincerely,

Arthur C. Graesser
Professor, Departments of Psychology and
Mathematical Sciences



Statement A per telecon
Susan chipman ONR/Code 1142
Arlington, VA 22217-5000

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Department of Psychology/Memphis, Tennessee 38152

ABSTRACT OF FINAL REPORT FOR GRAESSER'S ONR CONTRACT
"Questioning mechanisms during complex learning"

This research investigated the psychological mechanisms that underlie human question asking and answering during comprehension and complex learning. We believe that questioning mechanisms are fundamental components of human cognition and must be integrated in contemporary models of complex learning, curiosity, creativity, conversation, and intelligence. A scientific understanding of human question asking and answering also provides critical insights on how to design dialogue facilities in intelligent tutoring systems, expert systems, and human-computer interfaces.

The primary studies on this contract investigated question asking and answering during tutoring. We collected and analyzed the transcripts of 83 tutoring sessions on research methods (college students), 25 tutoring sessions on basic algebra (7th graders), and dozens of tutoring sessions furnished by colleagues. We analyzed the knowledge states, strategies, and interaction patterns of students and tutors during questioning. The questions were classified on several dimensions: degree of specification, content of information requested, and the psychological mechanism that generated the questions. These dimensions and categories were correlated with the students' depth of understanding the material. We found that students to some extent take an active role in self-regulating their knowledge by identifying their knowledge deficits and asking questions that repair such deficits. However, students need substantial training in improving their question asking skills. Most of the students' answers to deep questions asked by the tutor (e.g., why, why not, how, what-if) are poor in quality, so the tutor helps answer these questions in the form of a collaborative process that takes several conversational turns. We analyzed the structure of these interactions, the feedback supplied by the tutors, and the cognitive strategies that generated answers to the questions.

We conducted three auxiliary studies on question asking and conversation. In the first project, we designed a human-computer interface that facilitates the speed and quality of questioning, called the "Point and Query" (P&Q) interface. The student points to a word or picture element on the computer screen and then to a question about that element from a menu of relevant questions. The set of relevant questions and the answers to the questions are based on psychological models of questioning (including a model we have developed called QUEST). In the second project, we investigated the stimulus conditions that trigger questions when students comprehend text and attempt to solve mathematics problems. For example, questions are triggered when there is a contradiction, when anomalous information is inserted, and when critical information is deleted. In the third project, we analyzed sequences of speech acts when children interact in dyads in the context of free play, puzzle solving, versus the 20-questions game.

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